The petrogenetic meaning of schorl-dravite transition and apatite association in peri-amphibolitic tourmalinites – Northern Portugal

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In opposite sides of the massif of Serra de Arga, meta-volcanic to meta-sedimentary formations in Monteiro and Verdes include complex suites of amphibolitic rocks with unusual phosphate tourmalinites, mafic and felsic porphyroid proto-tuffs, stratiform tourmalinites, epidotites with graphite levels and phosphate meta-cherts. These rocks are interbedded with regional andalusite phyllitic formations.

The amphibolite lenses are small and have been transported by over-thrusting in structures lately reactivated as strike-slip shear zones. Amphibolite paragenesis holds anorthite, Fe-hornblende, F-rich sphene, fluorite, Cr-rich epidote, F-apatite, scheelite and sulphides. The peri-amphibolitic tourmalinites mainly located at the roof of amphibolite lenses may show distinctive textures and habits of tourmaline aggregates: T1 - massive monomineralic tourmaline and spindle-shaped agglomerations of tourmaline crystals; T2 - cataclastic aggregates with matrix phosphate; and disseminations in the amphibolites matrix and in altered mafic tuffs (Fig. 1). Different generations of tourmaline (schorl compositions and scarce dravite) were identified: G1 - early tourmaline (Fe, Al and□ X richer) affected by micro-displacements; G2 - crystals with oscillatory zoning; G3 - diffuse substitutions of G2 generation; G4 - dravite bands perpendicular to the c axis of G2; G5 - veinlet and micro-fracture remobilizations. F and Ti contents mark well the evolution between early compositions poor in Ti and F till late compositions with oscillatory enrichments.

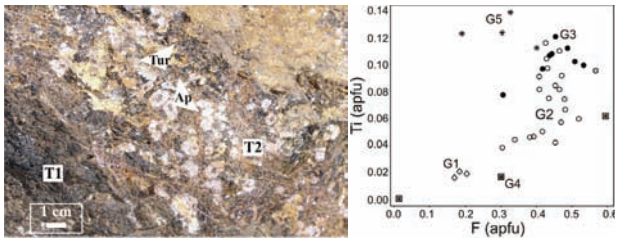

Fig. 1: Tourmaline / apatite textures and Ti/F constituents from T2 tourmalines (crystals G1 to G5).

The amphybolitic facies are interpreted as remnants of alkaline basalt compositions, which could evolve locally to intermediate or felsic end - members. Primary and proto - lithic boron enrichment might be related to proto - exhalitic and/or evaporite activity (compare to [1]), lately remobilized by hydrothermal fluids and contaminated by the various surrounding metassomatized rocks. Hypothetically, a fluid/magma P-saturated phase would be released from the alkaline trend, producing apatite enrichment. Textural relations between tourmaline and apatite seem to be remnants of an ancestral hydraulic breccia of "roof- rock" clasts.

Similarities between tourmaline compositions, here studied, and those occurring in neighbour stratiform tourmalinites, may suggest the introduction of B (± P) in volcanic spots, associated with deep faults, and the spread of metasomatism to adjacent, previously seated, sedimentary sequences.

[1] Byerly, G. & Palmer, M. (1991) *Contrib. Mineral. Petrol.*, **107**, 387-402.